3M Health Care Academy

Verification of Environmental Cleaning & the Impact on Patient Safety

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House Keeping

Continuing Education
Each 1 hour web meeting qualifies for 1 contact hour for nursing.
3M Health Care Provider is approved by the California Board of Registered Nurses CEP 5770.
Disclosure

• Steve Zeplin, RN, MSN, CSPDT
• Employee of 3M
• Sponsored by 3M

Objectives

• Review the fundamentals of cleaning verification
• Compare the different strategies for verifying environmental cleaning
• Summarize industry recommendations for environmental cleaning verification
• Analyze the evidence that cleaning verification impacts patient safety
What is one of the greatest risks to patients after admission to the hospital?

Admission to a room previously occupied by a patient who was colonized or infected with a multi-drug resistant organism.

**Underlying Elements that Contribute to Risk**

- MDRO and their persistence in the environment
- Transmission of MDRO from the environment to patients
- Suboptimal cleaning performance
- The environment is harder to clean

**MDROs Persist in the Environment**

- *Clostridium difficile* > 5 months to years
- MDR – Gram negative (e.g., *Klebsiella*) > 30 months
- Vancomycin Resistant Enterococci > 46 months
- Methicillin resistant *Staph. aureus* > 12 months
- Norovirus > 2 weeks
Transmission from environment to patient. Where does evidence come from?

- Modeling of Transmission Routes
- Observational Epidemiological Studies
- Intervention Studies
- Outbreak Reports

JA Otter et al. 2013 AJIC 41 S6-S11

Increased Risk Associated with Prior Room Occupant

JA Otter et al. 2013 AJIC 41 S6-S11

Fig 1. Chart showing the increased risk associated with the prior room occupant. The figures of difference in risk are unadjusted based on raw data. Several of the studies included adjusted measures of risk, but these were not included because of differences in study design. * Any patient infected or colonized with VRE in the two weeks prior to admission. † The immediate prior room occupant was known to be infected or colonized with VRE.
**Indirect Transmission from the Environment**

“With the pre-dominant focus on clean hands, there is less interest in the surfaces they touch. Even exceptional hand hygiene is rendered invalid if the first object handled transfers pathogens to the patient via fingertips....”

S. Dancer 2010. ICHE, 31(9) p. 958-960

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**Acquisition of C. difficile on hands after contact with skin and environment**

- Hand contamination after contact with skin sites: 50%
- Hand contamination after contact with high-touch surfaces: 50%

Slide courtesy of Curtis Donskey, MD Louis Stokes VA Cleveland, OH
Acquisition of MRSA on hands after contact with skin and environment

Skin contact: 40% of hand cultures positive

Environment contact: 45% of hand cultures positive

Slide courtesy of Curtis Donskey, MD  Louis Stokes VA  Cleveland, OH

References

• Boyce JM et al. Infect Control Hosp Epidemiol 1997;18:622-7;
Strategy to Manage Risk: Hospital Hygiene Bundle

“Interventions that are critical and effective for assuring a clean and disinfected environment”

Ruth Carrico, Ph.D, RN, FSHEA, CIC
Lead Clinical Advisor AHE
Clean Spaces Healthy Patients
http://cleanspaces.site.apic.org/tools-and-resources/tools-and-resources/

Proposed Bundle Elements

- Disinfectant: Selection and Proper Use
- Identification of surfaces and items to be cleaned/disinfected
- PPE: Selection and Use
- Clean/Disinfect Surfaces and items using correct techniques
- Identify and report breaches in Infection Prevention
- Follow Infection Prevention Practices
- Proper Hand Hygiene
- Monitoring effectiveness of cleaning/provide feedback
- Develop clear policies and procedures
- Effective education program

Ruth Carrico, Ph.D. Clean Spaces, Healthy Patients
Nancy Havill, CIC, Hosp. of St. Raphael, CT. APIC 2012 Clean Spaces Healthy Patients
Environmental Monitoring

- Ensure compliance to established protocols
- Identify problems and assess risk
- Define what “clean” means
- Ensure processes are under control
- Focus and drive process improvement
- Assess staff competency
- Confirm staff training

Monitoring means: Check, supervise, watch, keep track of….

How is environmental cleaning monitored?

- Visual Inspection
- Aerobic Colony Counts (ACC)
- Fluorescent Dyes/Powders/Gel
- ATP Bioluminescence
Monitoring the Efficacy of Environmental Cleaning: Who is doing what?

2013 Clostridium difficile infection (CDI) Pace of Progress Survey. Results of an online poll of 1,087 infection preventionists. APIC. March 2013

What do the guidelines say?

AORN – Association for Operating Room Nurses
APIC – American Association for Professionals in Infection Control
SHEA - Society for Healthcare Epidemiology of America
CDC – Centers for Disease Control and Prevention
**AORN: Guidelines for Environmental Cleaning**

- Perioperative personnel should participate in a variety of quality assurance and performance improvement activities that are consistent with the health care organization’s plan to improve understanding of and compliance with environmental cleaning.
- **Process monitoring must be a part of every perioperative setting** as part of an overall environmental cleaning program. Process monitoring should include:
  - Compliance with regulatory standards
  - Review of products and manufacturers’ instructions for use
  - Cleaning procedures
  - Monitoring of cleaning and disinfection practices
  - Reporting and investigation of adverse events (Example: outbreaks, product issues, corrective actions)
- Cleaning practices should be measured with qualitative and quantitative measures

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**APIC – Association for Professionals in Infection Control**

*The Implementation Guide for Prevention of Clostridium difficile*

[Link: www.apic.org/Professional-Practice/Implementation-guides]

This guide now contains numerous, multiple recommendations for incorporation of a monitoring program.

“Monitor adherence to cleaning and disinfection processes by personnel responsible for environmental cleaning.”

*The Implementation Guide also has a section dedicated to environmental monitoring technologies.*
SHEA: Society for Healthcare Epidemiology of America

SHEA Compendium 2014
Infection Control and Hospital Epidemiology July 2014, Vol. 35, No. 7

• Contains practice recommendations for prevention of HAIs

• Where applicable, implementation of monitoring to assess the efficacy of cleaning is now in recommendations.

• The Compendium is divided into several parts, monitoring recommendations/comments are located in those sections discussing MRSA and Clostridium difficile (where environmental transmission is a concern).

CDC: Options for Evaluating Environmental Cleaning

• This is NOT an official CDC guideline

• A tool kit that offers options for how to monitor environmental cleaning

• Be aware that there are inaccuracies in the descriptions on ATP technology and Microbial Culture and how they should be used.

• http://www.cdc.gov/hai/toolkits/Evaluating-Environmental-Cleaning.html
Cleaning – it not just about the microbes!

What are we really looking for?
- Microorganisms: bacteria, fungi, viruses
  - Microbes found in all soil components
- Tissue
- Blood and other body fluids
- Secretions/Excretions (vomit, diarrhea, mucous, phlegm, etc)

Can presence of soil be measured?
- Yes, but it is not easy

Current Standard Practice: Visual Examination

"Visual assessment is not an accurate measure of surface cleanliness nor of microbial contamination. It can be a misleading measure of cleaning efficacy."

Fluorescent Powders/Lotions/Gels
A surrogate soil

- UV fluorescent molecules are incorporated into water soluble gels, powders or lotions and used to mark an environmental surface.
- The surface is cleaned and then re-inspected by using a UVA light. The removal or partial removal of the fluorescent marker indicates if a surface has been wiped.
- Generate Qualitative Results: Has the surface been wiped? Yes/No
- Assesses compliance to cleaning protocols

Aerobic Colony Counts (ACC)

- Environmental surfaces are cultured for the presence of aerobic bacteria.
  - Swab surface and culture on nutrient media
  - Dip slides or RODAC plates – nutrient agar is pressed directly onto the environmental surface
  - Results are quantitative: CFU/ area tested

- Pathogens
  - Results are either
    - qualitative (presence/absence)
    - quantitative (provides a CFU count)

- Typically only performed during outbreaks
Adenosine Triphosphate (ATP) Bioluminescence

- ATP is present in all living organisms – animal, plant, microorganisms, human secretions and excretions.
- Contaminated surfaces show high levels of ATP, clean surfaces show low ATP levels.
- The surface is swabbed and the ATP levels measured in a luminometer.
- Results are quantitative: Measured in Relative Light Units (RLU).
- Benchmark RLU levels used to define “clean”

Simple Relationship

- Increase in clinical soil (including microorganisms)
- Increase in ATP levels
- Increase in light (RLU)
### Advantages and Disadvantages: Assessing Cleaning Practices

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>• Simple</td>
<td>• Not reliable measure of cleanliness</td>
</tr>
<tr>
<td>Fluorescent marker system</td>
<td>• Inexpensive</td>
<td>• Must mark surfaces before cleaning, and check them after cleaning</td>
</tr>
<tr>
<td></td>
<td>• Minimal equipment needed</td>
<td>• Does not provide quantitative measures</td>
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<tr>
<td></td>
<td>• Can improve practices</td>
<td></td>
</tr>
<tr>
<td>Aerobic colony counts</td>
<td>• Relatively simple</td>
<td>• More expensive</td>
</tr>
<tr>
<td></td>
<td>• Detects presence of pathogens</td>
<td>• Results not available for 48 hrs later</td>
</tr>
<tr>
<td>ATP bioluminescence assay</td>
<td>• Provides quantitative measure of cleanliness</td>
<td>• More expensive</td>
</tr>
<tr>
<td>systems</td>
<td>• Quick results</td>
<td>• Requires special equipment</td>
</tr>
<tr>
<td></td>
<td>• Can improve practices</td>
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John M. Boyce, MD, APIC 2010, Improving Cleaning and Disinfection and How to Monitor the Effectiveness of Surface Disinfection.

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### Monitoring Practices

- Cleaning practices CAN be improved with the implementation of performance monitoring and regular feedback.
- However, monitoring is not performed as frequently as needed, if at all....

Why do we not monitor?

- Time and $$
- Must be done on an on-going basis to be effective
- Lack of correlation to microbial counts taken as a negative
- Move to use of new technologies
  - new disinfectants
  - self-disinfecting surfaces (copper, silver)
  - no-touch automated disinfection (UV-C, VHP)

Should ATP measurements correlate with bacterial counts?

*Correlation should not be expected because:*

- ATP measures organic contamination from all living sources
  - Microorganisms, human cells, secretions, excretions, body fluids, food residue

- Bacterial counts measures bacteria only
  - **Correlation should not be expected as these two methods measure different things (well documented fact)**
Simple Scenario: A surface is soiled with blood

Bacterial results are zero, ATP results are high

- **Aerobic Plate Counts**
  - Only measures levels of live bacteria
  - Bacterial counts are zero but the surface could still be contaminated with
    - viruses (HIV, HepB,C)
    - anaerobic bacteria (C. diff)
    - Fungi, parasites

- **ATP Bioluminescence**
  - Measures removal of all organic soil including blood
  - Remove the soil, remove the bugs.....
    - viruses (HIV, HepB,C)
    - anaerobic bacteria (C. diff)
    - Fungi, parasites

The purpose of ATP Rapid Cleanliness Test

- Provides the answer to the following question:
- How much organic soil remains after cleaning?
The purpose of microbial surveillance
(aerobic bacterial plate counts)

• Answers two questions
• How many bacteria are present?
• Are they harmful?

New Technologies to eliminate human error

These will help with cleaning….. right??
We do not understand basic definitions

<table>
<thead>
<tr>
<th>Cleaning</th>
<th>High-Level Disinfection (HLD)</th>
<th>Sterilization</th>
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</thead>
<tbody>
<tr>
<td>• Removal of organic soil</td>
<td>• Microbial kill under defined conditions</td>
<td></td>
</tr>
<tr>
<td>• Microbes and soil can still be present</td>
<td>• Spores are not killed</td>
<td></td>
</tr>
<tr>
<td>• Device can still be infectious</td>
<td>• Effectiveness dependent on meticulous cleaning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Kills all living organisms including spores</td>
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Has anyone put all these new technologies into practice and published their findings?
Louis Stokes VA Medical Center
An Environmental Disinfection Odyssey

An Environmental Disinfection Odyssey: Evaluation of Sequential Interventions to Improve Disinfection of *Clostridium difficile* Isolation Rooms. Brett Sitzlar, BS; Abhishek Deshpande, MD, PhD; Dennis Fertelli; Sirisha Kundrapu, MD; Ajay K. Sethi, PhD; Curtis J. Donskey, MD. Infection Control and Hospital Epidemiology, Vol. 34, No. 5, Special Topic Issue: The Role of the Environment in Infection Prevention (May 2013), pp. 459-465

**Why do the study?**

**Problems with *Clostridium difficile* (C. *diff*)**

- Outbreak of *Clostridium difficile* infection (CDI) (2002-2004)
- High endemic rate: 15 in 10,000 patient days
- Environmental cultures were positive for *C. diff* after terminal cleaning
- What cleaning/disinfection improvements would result in consistently negative environmental cultures?
- Performed sequential interventions and then looked at effects on *C. diff* culture results and rate of CDI.
Intervention 1: Fluorescent Marker & Education

- 14% decrease in CDI rooms with positive cultures
- For individual sites the % of positive cultures was lower if marker was removed (28%) vs not removed (91%)
**Intervention 2: UV-C + Fluorescent Marker & Education**

- 48% decrease in CDI rooms with positive cultures (lower than expected)
- Cleaning was suboptimal when UV device was used: <50% marker removed

**Intervention 3: ATP monitoring, daily cleaning + Intervention 2**

- 89% decrease in CDI rooms with positive cultures
- All cultures were negative both pre and post UV treatment suggesting eradication of *C. diff* was due to enhanced cleaning
Health-care associated CDI rates

- During Period 1 and 2 rates remained stable at 10 per 10,000 days of care.
- During Period 3 rates dropped to 6 per 10,000 days of care.
- Authors suggest more study is needed to see if the drop in CDI rates could be sustained.

Conclusions

- Education alone does not work
- Fluorescent marker (FM) technology greatly improved compliance with wiping correct surfaces but only had “modest impact on residual C. diff spore contamination.”
  - Supports growing body of work that shows FM do not provide assurance that pathogens are removed from a surface
  - FM shows a surface has been wiped, not that it is clean
- UV devices can be helpful but use with strong caution
  - Cleaning efforts declined due to misconception that the UV device BOTH cleaned and disinfected surfaces
  - UV devices may be more effective on surfaces with direct exposure vs indirect exposure
Conclusions: Two strategies worked to achieve consistently negative C. diff cultures

- Dedicated CDI daily disinfection team
  - Keeps C. diff levels down, decreases chance of HCW hand contamination
  - Provides multiple opportunities to remove environmental contamination
  - Dedicated team removes issues of worker variability
- Rooms cleared by EVS supervisor or Infection Control
  - ATP readings (< 250 RLU) provided objective measure of cleanliness and allowed for implementation of standardized process for clearing rooms
  - Required little time (1-2 hours per week)
  - Provided opportunity for direct observation and real-time feedback to EVS staff

My Comments

- Monitoring technologies: ATP vs FM
  - One is not better than the other, they address different questions
- Monitoring & NTD Technologies do not replace:
  - Proper cleaning
  - Communication
  - Education
- Be aware of the limitations of each approach
- A combination of technologies looks to be most effective
Conclusions

Studies indicate that environmental cleaning and disinfection interventions can reduce the acquisition of healthcare-associated infections.

- Ongoing Education & Training
- Environmental Monitoring with Feedback
- No Touch Disinfection Technologies
- Dedicated cleaning teams
- Enhanced cleaning and disinfection protocols

HAI Elimination is a Continuous Improvement Process
Thank you